

Hormones and Me
**Disorders of the Thyroid Gland
in Children and Adolescents**



Australasian Paediatric Endocrine Group

Disorders of the Thyroid Gland in Children and Adolescents



Table of Contents

About this Book	2
Introduction	3
Structure and function of the thyroid gland	3
Hypothyroidism	5
Acquired hypothyroidism	5
Symptoms and signs of hypothyroidism	5
Diagnosis of hypothyroidism	6
Treatment of hypothyroidism	12
Congenital hypothyroidism	13
Iodine deficiency disorders	13
Hyperthyroidism	16
Causes of hyperthyroidism	16
Symptoms and signs of hyperthyroidism	18
Investigations for an overactive thyroid	20
Anti-thyroid drug treatment	21
Treatment of other types of overactive thyroid	24
Questions and Answers	30
Glossary	33
Support Organisations and Further Reading	38
References for Text	39
Hormones and Me Booklet Series	40

About this Book

This booklet, Disorders of the Thyroid Gland in Children and Adolescents, aims to give you a basic understanding of how thyroid disorders are diagnosed, the types of treatment available and the sorts of problems you may encounter. It has been written to give you a brief overview of the different conditions and not all of the information provided will be relevant to everyone with a thyroid disorder.

We encourage you to discuss any additional questions or areas of concern with your doctor after reading this booklet.

Merck Serono Australia are proud to bring you this booklet from the Hormones and Me educational series. We hope that you find it a valuable and helpful resource.

This booklet was produced in 2016 by Professor Margaret Zacharin, a Paediatric Endocrinologist specialising in childhood endocrine disorders and a member of the Australasian Paediatric Endocrinology Group (APEG).

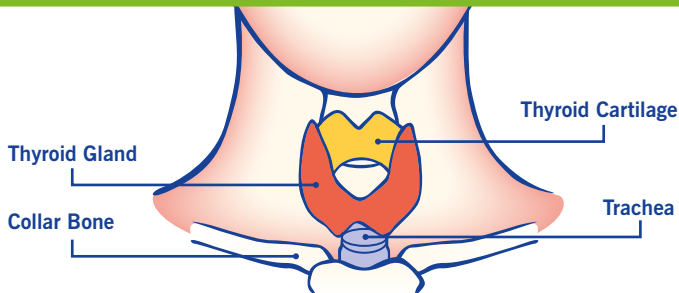
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Introduction

Structure and function of the thyroid gland

The thyroid is a small gland situated in the lower part of the neck. It has two parts (lobes) joined in the middle and is roughly the shape of a butterfly. Although it can be seen and felt by a doctor, it is not usually obvious to a person looking at the neck. While it is small in size, it has a very important function, which is to produce hormones (circulating proteins) which carry messages from one part of the body to another. These thyroid hormones are responsible for helping with daily functioning of most parts of the body. In fact, they are essential for life and to maintain normal health. If the thyroid gland does not produce enough thyroid hormone (hypothyroidism), every part of the body slows down: a child's growth becomes slow with a tendency to weight gain, feeling cold and sluggish, with dry skin and hair, low heart rate and constipation. Conversely, if there is too much thyroid hormone (hyperthyroidism), every function of the body speeds up with rapid growth, weight loss despite a good appetite, rapid heart rate, sweating, and shakiness. Symptoms are explained in more detail in the following pages.

The shape and position of a normal thyroid gland



Disorders of the Thyroid Gland in Children and Adolescents

Problems within the thyroid gland can be due to abnormalities of its structure or its function. These problems may occur from before the time of birth or may be acquired later, at any time in life. A tendency to have any type of thyroid problem may run in families, and a risk for some types of thyroid disorder may be inherited on either side of the family or sometimes from both the mother and father's side.



Hypothyroidism

Acquired hypothyroidism

Underactivity of the thyroid gland is a very common problem, seen more often in women than men (five times as many women as men have hypothyroidism problems). It is less common in children, even if there is a strong family history of the condition in adults within a family. Some conditions such as Trisomy 21 (Down syndrome) have a predisposition to develop an underactive thyroid with the passage of time.

Symptoms and signs of hypothyroidism

Children who have poor thyroid function often do not complain of feeling unwell. Even when the problem is extremely severe and longstanding, it may not be obvious to families or even to a doctor looking after the child. If the thyroid is underactive and unable to make a normal amount of thyroid hormone, the whole body simply slows down. Typical features include a slowing down of growth (with gains in height being lower than expected), together with a tendency to gain weight. However, although many families may think that an underactive thyroid may be leading their child to gain weight, this is very uncommon if weight is the only problem. More commonly weight gain is due to excessive calorie intake and lack of exercise. In these situations, a child tends to grow very fast and to be bigger than his or her peers. Only in the situation where there is weight gain along with very slow growth is it more likely that there may be an underlying medical problem, such as an underactive thyroid.

Disorders of the Thyroid Gland in Children and Adolescents

Although thyroid hormone is required for brain function, a child who has developed an underactive thyroid may continue to do quite well at school and may not have noticeably slowed down mentally. There may be some physical slowing down of activity, but this is usually not noted by families. If the problem is severe the child may complain of feeling cold, the hair becomes dry and brittle, the skin is dry, and the pulse rate is slow. A complaint of constipation is not uncommon. In rare cases there may be swelling of the calf muscles of the leg, looking as if the child has large muscles in this area. Despite this long list of possible symptoms of an underactive thyroid, most children appear normal. The majority of children who have even very severe hypothyroidism look perfectly normal. The most common way in which a child with this type of condition comes to medical attention is due to his or her growth slowing in comparison with siblings or other children of the same age.

Diagnosis of hypothyroidism

The diagnosis of hypothyroidism can be made by a simple blood test to check thyroxine and thyroid stimulation hormone (TSH). Thyroxine is the main thyroid hormone that circulates in the bloodstream. TSH is a hormone produced in the brain that tells the thyroid gland how hard to work to get normal thyroxine levels. When the thyroid hormone level in the blood is low, the TSH level becomes very high as it is trying to send a message to a poorly functioning thyroid gland to make it work harder. Antibody testing can be helpful.

There are a number of known causes for underactivity of the thyroid gland in children, but sometimes an exact cause cannot be found.



1. Autoimmune thyroiditis (Hashimoto's disease).

An autoimmune process occurs when the body sees part of itself as being abnormal, although it is not, and tries to attack it, similar to the way in which the body fights infection. In the case of Hashimoto's thyroiditis, the immune process is directed against the thyroid gland and over time may gradually destroy it.

During this immune attack the thyroid gland can become inflamed. It can swell in size so that it may be detected by the family or doctor, due to the presence of the enlarged gland appearing as a lump in the lower neck.

Confusingly, during this process of initial inflammation the gland may sometimes produce larger amounts of thyroid hormone than usual, causing mild over activity of the thyroid hormone production (hyperthyroidism). The child might then become hot, anxious, irritable, and shaky for a few weeks. By the time the family have noticed a problem this overactive phase has often passed, therefore, it is quite uncommon for a child to complain about, or to be diagnosed with, the overactive component of Hashimoto's thyroiditis.

Then, over weeks or months, the child's thyroid becomes underactive as the inflammatory process gradually destroys the gland. Eventually a diagnosis is made, with complaints of tiredness, sluggishness or other symptoms outlined previously.

The diagnosis of autoimmune thyroiditis can be confirmed by a blood test measuring the specific antibodies which are attacking the thyroid gland.

Disorders of the Thyroid Gland in Children and Adolescents

Generally speaking, children have healthier bodies than adults and, as such, are often more able to respond quickly and adequately to any health problem. Nearly half the children who have a diagnosis of Hashimoto's thyroiditis do not need treatment. The underactivity of the gland can be extremely mild, with minimal changes in thyroid hormone levels. This is known as subclinical hypothyroidism. If watched carefully over 12 months at regular intervals, the problem often resolves without need for any treatment at all. However, the gland may be very badly damaged by the immune attack and may become progressively underactive, in which case treatment is needed.

Once hypothyroidism is diagnosed thyroid hormone replacement treatment will be needed and may be life-long. Occasionally, after completion of normal linear growth and puberty is complete, it may be possible to have a trial period where thyroid hormone replacement is stopped. This needs to be carefully supervised by your doctor.

Children with Trisomy 21 (Down syndrome) often have an underactive thyroid. This may be due to a small, poorly formed thyroid gland detected in infancy or due to an increased lifetime risk for Hashimoto's disease compared with other children. Children with Trisomy 21 should, therefore, have annual tests for thyroid function (and even more frequent testing when they are very young).



2. Subacute thyroiditis

(sometimes known as De Quervain's thyroiditis).

This is an unusual condition, with inflammation of the thyroid gland sometimes occurring after a viral infection, although often the exact cause cannot be identified. The child or adolescent may complain of severe discomfort in the lower part of the neck in the position of the thyroid gland and symptoms of thyroid overactivity may occur (see section on hyperthyroidism). If the pain and swelling are severe, a non-steroidal anti-inflammatory tablet can be very helpful over a few weeks, until the inflammation settles. Usually, after a few weeks or months, this condition gets better spontaneously and the function of the gland returns to normal (permanently). However, if the damage to the gland has been very severe the gland may become woody and hard in texture and possibly permanently underactive, occasionally requiring long-term treatment with thyroxine.

3. Dyshormonogenesis.

There are many genes known to cause dyshormonogenesis (an inability to make normal thyroid hormones). The condition is often picked up on a routine thyroid screening test in the few days after birth and treated from that time, particularly if there is a very strong family history. However, dyshormonogenesis may not be detected until the child is older, often between 2 and 4 years of age, when a goitre is noticed. Sometimes it is not picked up until even later, such as during teenage years.


Disorders of the Thyroid Gland in Children and Adolescents

Enlargement of the thyroid gland with low thyroid hormone levels may suggest this diagnosis. A special type of scan (nuclear medicine scan) of the gland usually shows very high uptake of an injected substance. This is because the gland is able to take up the scanning material which it thinks is similar to iodine, but is not able to use it properly and therefore it accumulates within the gland.

Early treatment of this type of thyroid disorder is extremely effective, with shrinkage of the gland to normal size. Treatment should be continued permanently to ensure that the gland remains small and that the function remains normal. Often only very small doses of thyroid hormone are required to normalise the levels and to shrink the gland. However, if treatment is not continued the gland tends to enlarge with time and can become unsightly. It becomes lumpy and uncomfortable in the neck and eventually may even require surgery to remove the enlarged gland. Furthermore, there is an increased lifetime risk for thyroid cancer in these situations where the gland is bulky, disorganised and large. This problem can occur if insufficient or intermittent replacement of thyroxine has been given. For these reasons continuing regular check-ups with your doctor and regular thyroid hormone intake are essential.

4. Other causes of hypothyroidism.

These conditions are relatively rare, in comparison with the problems outlined above. Some drugs, including aluminium hydroxide, amiodarone (a drug used for the management of abnormal rhythms of the heart), lithium (used for certain psychiatric conditions), and cholestyramine (used for rare disorders of high cholesterol) can all cause an underactive thyroid. Any person taking these medications must have regular thyroid tests.



In addition, an underactive thyroid is extremely common after radiation exposure for any reason, such as after treatment of a brain tumour or other cancers where the head and neck have been exposed to radiation, or when a child or adolescent has been treated for an overactive thyroid with a dose of radioactive iodine. Careful follow-up in all of these situations is required (see later section on thyroid cancer).

5. Maternal thyroid function.

If a pregnant woman is known to have Hashimoto's thyroiditis with hypothyroidism and has a need for thyroid hormone replacement, then the autoimmune process can be transferred to her infant in the womb. Most infants with transient hypothyroidism born to mothers with Hashimoto's thyroiditis are identified by routine neonatal thyroid TSH screening. Infants of mothers with Hashimoto's thyroiditis should have the routine Newborn Screening TSH measurement on day 3 or 4 of life. The evidence for retesting is not compelling, but some recommend retesting at 2–4 weeks. These tests make sure they have not developed an underactive thyroid due to the transfer of the mother's antibodies (thyroid peroxidase or TPO antibodies). Fortunately, this condition will get better and disappear when the mother's antibodies disappear, which is usually around 12 weeks after birth. However, rarely, treatment with thyroxine might be required within the first few weeks of life.

Disorders of the Thyroid Gland in Children and Adolescents

Treatment of hypothyroidism

Treatment of an underactive thyroid is extremely simple. Thyroid hormone levels are returned to normal levels by taking daily thyroxine tablets (thyroid hormone replacement treatment). Thyroid hormone tablets are small and easy to swallow, even for a very small child. They are tasteless and very effective. They have an extremely long duration of action so that if a tablet is missed the missing tablet can be given, either later the same day or as a double dose the next day. Clearly this is not a plan that should be followed regularly, but is perfectly safe for occasional circumstances when tablets are forgotten.

No child or adolescent is able to be consistently accurate in remembering to take any medication. Adequate adult supervision should be given at all times.

Like all medications, thyroid hormone tablets should be kept away from infants and small children, in a safe place. It is usual for the tablets to be kept in the refrigerator in individual aluminium foil packaging. Optimal treatment recommendations are for the medication to be taken two hours apart from a meal. However, sometimes these instructions result in patients missing tablets frequently and such limitations can result in very poor and erratic intake of treatment. Under these circumstances, if chronic tablet omission is a big problem, it is probably better to keep the tablets somewhere that they can be taken regularly, without forgetting. Iron tablets and soy milk can both interfere with absorption of thyroxine and should therefore be avoided or taken at different times of the day. If this is not possible then larger doses of thyroxine may be needed and more frequent monitoring of thyroid hormone function should be undertaken.



Congenital hypothyroidism

When a baby is born with an abnormality of the thyroid gland this is known as congenital hypothyroidism. Conditions relating to this type of thyroid disorder are explained in a separate Hormones and Me booklet entitled Congenital Hypothyroidism.

Briefly, this type of disorder may be due to the thyroid gland not being formed at all (athyreosis), or the gland having been formed but not having descended to its usual place in the neck. In this case, it is found high up behind the back of the tongue (where it starts its development in the foetus) and does not function properly (lingual thyroid). Less commonly the thyroid gland is formed properly, but is not able to make its hormones correctly. As a result, the gland becomes larger, trying to work properly, but the function is inadequate (dyshormonogenesis).

All of these problems are able to be diagnosed within a few days of birth in many countries, where a screening program allows detection of any insufficiency of the thyroid gland function. Once these problems are detected, appropriate treatment can be started. Treatment remains life-long for almost all affected children.

Iodine deficiency disorders

The thyroid gland makes its hormones in a complicated sequence of steps. This commences with the presence of iodine. A protein structure is built around the iodine to make functional thyroid hormones. Iodine is a natural element found in the environment. It is essential for normal thyroid hormone production. In some countries, or particular areas of countries, there is a lack of iodine. If this lack is severe, the thyroid gland is unable to

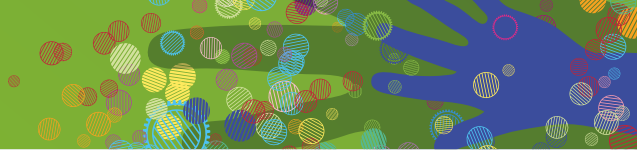
Disorders of the Thyroid Gland in Children and Adolescents

make its hormones properly and becomes severely underactive as a result. It is a very serious condition, affecting many people in iodine deficient areas, with many millions of cases of iodine deficiency reported around the world. Babies who are born to mothers with severe iodine deficiency may have very poor brain development and poor growth. If untreated, this condition is life-long and is known as cretinism. For older people, as iodine deficiency worsens, the thyroid gland becomes extremely large while trying to make its hormones properly.

Fortunately, around the world, enormous efforts have been made to correct the problem of iodine deficiency, often by compulsory iodisation of salt. Some countries have employed iodine supplementation of bread as an alternative strategy to ensure that the whole population has enough dietary iodine.

Diagnosis of iodine deficiency

Iodine deficiency is diagnosed in a community by collection of large numbers of urine samples from thousands of members of a population and by measuring the levels of iodine present in urine. This gives an excellent and accurate idea of the iodine status of a population. However, measurement of urine iodine is not helpful in a single individual as it simply reflects the iodine content of the previous food intake over the 12 hours prior to the urine sample being taken. Provided a suitable vehicle for iodine is provided in your community, such as iodised salt or iodised bread, iodine deficiency should not be contributing to your own, or your child's, health.



Problems of iodine excess

The thyroid gland is capable of using quite large amounts of iodine. It can become overactive if excess iodine is consumed. Conversely, if excess iodine is given to a child, the gland can become confused by the large amounts of iodine, and its hormone production can actually become blocked. It is then unable to function properly and cannot make its normal hormones. It is, therefore, unsafe to take large amounts of iodine supplements such as iodine drops or kelp tablets containing iodine.

Disorders of the Thyroid Gland in Children and Adolescents

Hyperthyroidism (Thyrotoxicosis)


Causes of hyperthyroidism

There are a number of causes of hyperthyroidism in children and adolescents. The most common of these conditions is known as Graves' disease.

Graves' disease

This is an autoimmune condition where the body overstimulates the thyroid gland, causing it to produce excessive amounts of thyroid hormone. Once established, the process tends to go on for at least 10–15 years. In children, the chances of a spontaneous remission with treatment is much lower than in adults, and overall is of the order of 20–30%. The chance of a remission in certain ethnic groups, such as those from South East Asia, is much lower and may be as low as 5–10%. To achieve any hope of a long remission, treatment is required for at least 18–24 months. If treatment is ceased earlier, then symptoms will usually return very rapidly. If treatment is not given regularly the thyroid gland may become very large in size and may become extremely difficult to treat effectively.

Graves' disease often presents with the symptoms of hyperthyroidism described above. All children and adolescents with an overactive thyroid tend to have rapid, disorganised thought processes and very poor concentration skills while the thyroid is overactive. Their ability to remember to take medication is extremely limited and they need regular parental supervision. While the thyroid is extremely overactive, metabolism is very fast and treatment needs to be given three times per day, spread out over the 24 hours. As the condition settles, the number of doses of medication can be reduced, as well as the quantity of medication. This should be done under the close supervision of a specialist endocrinologist.



Sometimes in Graves' disease the eyes are very prominent or pushed forward by inflammatory tissue behind the eye. If the condition is severe, eye movements may be limited due to swelling of the muscles around the eye needed for normal eye movement. This can also cause double vision. More commonly, there is mild swelling of the surface of the eye (conjunctiva) causing itching and redness. It may look as if the child has an eye infection. Occasionally, if the problem is severe, then a child will not be able to completely shut his or her eyes during sleep, exposing the surface of the eye to irritation on the pillow. If this occurs the child should be encouraged to try and sleep on his or her back to avoid the problem. Very occasionally, taping of an eyelid to keep it shut during sleep is required.

Eye problems related to Graves' disease are relatively uncommon in children and even when present are usually mild and do not need treatment (other than to wear sunglasses or protective glasses during exposure to wind).

Sometimes Graves' disease is easy to manage, with an initial large dose of anti-thyroid drug being able to be reduced quite rapidly over 2–3 months, to a maintenance dose at a low level, often only half to one tablet per day. However, if this very low dose is ceased the condition tends to come back (relapse) very quickly. In other people the condition can be much more difficult to treat, and even very small changes in medication can result in difficult to control thyroid hormone levels, from overactive to underactive. Occasionally a 'block and replace' regime of treatment is required. In these situations a large dose of an anti-thyroid drug is given to completely block the gland along with thyroxine to replace the gland's necessary function. This can result in more stable management, but is only rarely required.


Disorders of the Thyroid Gland in Children and Adolescents

Treatment with anti-thyroid drugs is usually given for 18–24 months and then the dose is weaned and ceased. Close supervision is required to see whether the condition returns (relapses). However, a decision needs to be taken with the family and the doctor as to whether it is appropriate to cease treatment under some circumstances. If an adolescent is nearing the end of secondary schooling it may be inappropriate to cease treatment towards the end of the last two years of schooling. Under these circumstances it may be better to continue treatment until the exam period and schooling is complete.

When treatment is ceased, regular monitoring and blood tests, initially every six weeks and then every three to six months, are required to make sure that recurrence of the condition is not missed.

Symptoms and signs of hyperthyroidism

Adults who have thyroid overactivity usually feel extremely unwell with a tendency to weight loss, anxiety, shakiness, a fast, erratic heart rate, sweating, poor exercise tolerance and poor sleep. However, these symptoms are far less common in children and for this reason a diagnosis of an overactive thyroid is often not made for many months after the symptoms have commenced.



Features are often subtle, including reduced concentration and a complaint by the school teacher of deteriorating school function reflected in less good school marks over the last preceding couple of terms. Although weight loss is extremely common, most families do not recognise it and think that their child or adolescent is undergoing a growth spurt. Whilst an extremely overactive thyroid can be associated with slightly faster growth and increase in height, it is usually the failure to gain weight or weight loss that causes the appearance of a 'growth spurt'. Sleep disturbance with difficulty getting to sleep at night is also a common complaint seen by parents, although most children do not recognise it.

The commonest age for thyroid overactivity to be detected in childhood is between the ages of 9 and 15 years, but it can occur in a younger child, although it is uncommon under the age of 3 years.

Examination of a person with an overactive thyroid will usually reveal moist and warm skin, a fast pulse, and a fine tremor. Muscle weakness and wasting, a tendency to mild hair loss, and an enlarged thyroid gland are also often found.

The eyes may also be involved with an overactive thyroid when the condition is known as Graves' disease. In this case the child may appear to be staring, with less blinking than usual. (See Causes of hyperthyroidism for details).


Disorders of the Thyroid Gland in Children and Adolescents

It is important for the doctor to examine the thyroid gland. This helps to detect the type of thyroid overactivity. If the gland is extremely tender it indicates inflammation which is likely to settle without much treatment. If the gland feels hard and 'woody' it may be Hashimoto's disease. This type of thyroid overactivity is likely to settle quickly. A gland with Graves' disease is usually enlarged, soft and painless.

Investigations for an overactive thyroid

An overactive thyroid gland can be easily diagnosed by a blood test for thyroid hormones. There will be a high level of thyroxine (free T4) and of triiodothyronine (free T3). The T3 is the active thyroid hormone responsible for symptoms and complaints of overactivity. As thyroid hormone levels rise, the messenger hormone from the brain (TSH) switches off and becomes unmeasurably low when using standard laboratory tests.

A specific thyroid hormone receptor antibody can be measured in the blood. If raised it confirms a diagnosis of Graves' disease. Other antibodies (thyroid peroxidase [TPO] and thyroglobulin [Tg]) are not specific, but can help the doctor decide which type of thyroid problem is present.



Sometimes a small nodule of thyroid tissue may be overactive. A special nuclear medicine scan of the thyroid gland can be helpful to confirm that overactivity is present throughout the thyroid gland. In these cases, surgical removal of the nodule or radioactive iodine treatment may be indicated. In other cases, standard ultrasound scanning will demonstrate a uniform enlargement of the thyroid gland. Neither of these tests (the nuclear medicine scan or the standard ultrasound scan) is essential to diagnose Graves' disease, but they may be extremely useful if there is suspicion of a different type of thyroid overactivity, such as in a single lump.

Anti-thyroid drug treatment

There are two types of anti-thyroid drugs, known as carbimazole (methimazole in the USA) and propylthiouracil (PTU). Both drugs are associated with the possibility of allergy and possible side effects, but propylthiouracil has a more adverse side effect profile than carbimazole and for this reason it is not used except in special circumstances.

Side effects can include rash (urticaria), a lowering of the white blood cell count (which is reversible (agranulocytosis)), muscle aches and pains, and nausea. This can occur at any time in treatment. Side effects are more common with higher doses of treatment and in the early months, but after treatment commences it can occur even years after treatment was commenced. Side effects are not able to be predicted by regular blood tests. No particular person or age group appears to be at a specific increased risk.

Disorders of the Thyroid Gland in Children and Adolescents

Propylthiouracil (PTU) has been associated with sudden onset liver failure which can be fatal. For this reason it is not used in normal circumstances. However, carbimazole has not been shown to be safe during the first trimester of pregnancy as it is associated with abnormalities in formation of the foetus. Propylthiouracil is therefore used, when necessary, for treatment of thyrotoxicosis in the first three months of pregnancy. PTU can also be used if there is allergy to carbimazole. In this circumstance it is usual to change from one drug to the other for a short term only while making a decision about definitive treatment with either surgery or radioactive iodine.

If Graves' disease does relapse, then there are a number of different treatment options. None of these are perfect and each individual family needs to consider which option is most appropriate for them. Different countries in the world tend to have different preferences for definitive management of this condition. Options for long term management are as follows.

1. Continuing long-term treatment with anti-thyroid drugs.

This needs frequent supervision, frequent blood tests, and carries with it a possible risk of allergy or side effect from the drugs. Unfortunately allergies and side effects can occur at any time, even when a patient has been taking the medication for several years. It is totally unpredictable. Side effects can be severe (see section on drug treatment). For this reason, very long term treatment with anti-thyroid drugs is usually not recommended or chosen by families.



2. Surgery.

Modern surgical technique with near total removal of the thyroid gland is satisfactory as a treatment for Graves' disease. However, surgery carries risks associated with anaesthesia and the surgical treatment itself. Any surgery must be undertaken by a specialist surgeon who does thyroid surgery on a regular basis, in order to reduce the risk of any adverse effects. Removal of the thyroid will result in a need for thyroid hormone replacement permanently. A faint scar at the base of the neck is inevitable. This scarring may be much more prominent in people with darker skin tones. Some skin types are also prone to develop a thick, pink scar (keloid), which may be transient or may occasionally last for months or years.

3. Radioactive iodine (I-131).

Different countries have different preferences as to whether they use surgery or radio-active iodine. This treatment sounds dangerous but is quite safe, aiming to give a large enough dose of radioactive iodine to be taken up into the thyroid gland to destroy the gland completely. This type of treatment is not the same as external radiotherapy used for cancers and does not have the same side effects. Radioactivity that does not go directly to the thyroid gland is minimal, with only a tiny amount taken up into the salivary glands and the stomach. The remainder of the radioactivity is excreted in the urine over the next 2–3 days after administration of the dose. Such treatment is not associated with long term risks for cancer or infertility. It is generally considered to be the most effective treatment with the least risk to the patient. However, it is not wise to request a small dose of radioactive iodine, hoping to make the thyroid gland 'normal', so that no thyroid replacement treatment is needed. A low dose can often result in a relapse of the condition as well as a high risk of developing a lumpy thyroid gland in the future.


Disorders of the Thyroid Gland in Children and Adolescents

If radioactive iodine is to be used, there are specific instructions that must be followed in order for treatment to be effective. The anti-thyroid drug must be stopped for four days before and after the dose of radioactive iodine in order to allow it to be taken up into the thyroid where it can destroy the overactive process. Anti-thyroid drugs are then restarted for 6 to 12 weeks by which time the gland should have become underactive. Anti-thyroid treatment can then be stopped and thyroxine replacement will be commenced and required long term.

Sometimes a second dose of radioactive iodine may be required 6 months after the initial dose, to completely and effectively treat an overactive thyroid. Doses are deliberately and legally limited to prevent unnecessary exposure of the family members to a radiation hazard. For the same reason, it is a legal requirement that persons having therapy of radioactive iodine do not attend school for a restricted period which varies from 3–7 days depending on the reason for the therapy. This time varies for patients with thyrotoxicosis and thyroid cancer and should be discussed with the nuclear medicine physician. The treated patient should keep away from contact with children under 5 years and pregnant women for 5–20 days depending on the reason for the therapy.

Treatment of other types of overactive thyroid

The overactive phase of Hashimoto's disease or other inflammation of the thyroid often does not even come to medical attention. However, sometimes a short course of medication to slow the heart rate and to reduce anxiety may be needed for a few weeks. Occasionally anti-thyroid drugs might be needed for these conditions but this is unusual.



A single thyroid lump (adenoma) is very uncommon in children and young adolescents, although this type of condition is more frequent cause of thyroid overactivity later in life. It needs treatment with anti-thyroid drugs, then either surgery or radioactive iodine for cure. A single lump in a thyroid should be carefully checked as it might be a cancer.

Foetal and neonatal thyrotoxicosis

If a mother has an overactive thyroid during pregnancy or if she has been treated for Graves' disease in the past either with drugs, surgery or radioactive iodine she may still have circulating thyroid stimulating antibodies (TRaB) in her blood. These antibodies may be transferred to a developing baby. It is very important for a pregnant woman to tell her obstetrician if she had Graves' disease in the past. If a mother has previously had Graves' disease it is advisable for her to be closely monitored during the pregnancy. Specific antibodies for Graves' disease will be checked in order to predict the likelihood of hyperthyroid problems occurring in the pregnancy or in the baby. If a mother has active Graves' disease during pregnancy and if she needs continuing medication with anti-thyroid drug after the birth of the baby, she can safely breastfeed while continuing her treatment.

For those mothers who are actively being treated for Graves' disease during a pregnancy, the risk of having an affected baby is clearly higher. However, the condition is still rare and only occurs in about 1:1000 of those pregnancies complicated by thyrotoxicosis.


Disorders of the Thyroid Gland in Children and Adolescents

Foetal thyrotoxicosis is detected in the later part (third trimester) of pregnancy with poor growth of the baby and a rapid heart rate. It is possible to treat this by treating the mother with high doses of anti-thyroid drug, so that some of it gets through to the baby. After birth, very careful monitoring and treatment will be required for several weeks.

Neonatal thyrotoxicosis is more common but still relatively rare. The baby may develop symptoms and signs of an overactive thyroid within days of birth. The child will be irritable, failing to gain weight and have a very fast heart rate. Sometimes this condition is not picked up until the baby even develops heart failure from the stress of the thyroid overactivity. The condition is easily detected with a thyroid function blood test and is treated with carbimazole. Treatment is usually only required for 9–12 weeks after birth, by which time the mother's antibodies disappear and the child becomes normal. Extremely rarely it may be a much longer term problem and may require years of treatment.

Multinodular goitre (MNG)

This is a lumpy thyroid gland, sometimes noticed by a family member and sometimes by a doctor during a routine visit for other reasons. It is not commonly seen in children unless there is a strong family history of a similar problem. In countries where close cousin marriages are common, multinodular goitre due to dyshormonogenesis is seen more often (see section on hypothyroidism). There are also a number of rare genetic causes for this problem. Specialist assessment for a child or adolescent with a MNG is recommended.



Thyroid ultrasound is useful to diagnose a MNG. Thyroid function is usually normal and remains normal with time, although both over and underactivity of the gland may occur. Treatment with thyroxine is often given but has not been shown to reduce the gland size. If the gland becomes very large and unsightly surgery may be needed.

Thyroid cancer

Thyroid cancer in childhood is becoming more common, as the majority of children and adolescents now survive treatment for various types of childhood cancer. Where a child or adolescent has been exposed to radiation, either for treatment of a brain cancer, head and neck cancer, total body irradiation prior to a bone marrow transplant, or occasionally local radiation for chest cancers, the thyroid is inevitably exposed to some of that radiation hazard. It responds by developing lumps (nodules) which have the potential to become progressively more abnormal with time and which can develop cancer within them. Sometimes thyroid cancer can arise spontaneously in a child who has not been exposed to any type of radiation in the past.


Very rarely if a mother has been exposed to inadvertent radiation during the second and third trimester of a pregnancy (e.g., with scanning material used to investigate possible pulmonary embolus or other health problems, or where a family has lived in the vicinity of a nuclear radiation hazard), a child's thyroid may have been inadvertently exposed and develops an increased risk of cancer. Cancer risk after radiation exposure rises with the passage of time, increasing from about six years after radiation exposure to a maximum risk by 20–25 years, although lifetime risk continues to be increased and follow-up is required permanently.

Disorders of the Thyroid Gland in Children and Adolescents

Thyroid cancer is usually detected by the finding of a lump in the front part of the neck. Occasionally the child or adolescent may present for the first time with a lump found in the side of the neck due to spread of cancer into nearby lymph glands. This is, however, very uncommon.

A diagnosis is made by confirming the presence of a lump with ultrasound and a nuclear medicine scan. Usually thyroid cancer is incapable of taking up any of the scanning material and the lump will appear to be solid but shows an absence of uptake ('cold nodule'). A needle biopsy, known as a fine needle aspiration, is usually undertaken to demonstrate the presence of cancer. This has a high chance of identifying such a problem but there is around 5–10% chance of missing a cancer based on this test. Sometimes surgical removal of the lump is considered to be necessary to make a clear diagnosis.

Once a diagnosis has been made, treatment is necessary with total removal of the thyroid gland. Modern surgery for thyroid cancer in childhood and adolescence usually involves removal not only of the whole thyroid gland but also removal of the main lymph nodes of the neck. This results in a much lower recurrence rate in future and is not disfiguring to the affected person.



Thyroid hormone replacement is then given. Around 5–6 weeks after surgery, a whole body radioactive iodine scan is undertaken to see whether there is any residual or remaining tissue that might need to be removed or treated with radioactive iodine. If there is any tissue remaining it is usual to give a dose of radioactive iodine which is taken up into any active tissue around the body and destroys the remaining cancer.

If a dose of radioactive iodine is to be given it is necessary for the child or adolescent to cease thyroid hormone treatment, and to avoid intake of any iodine rich foods for several days before treatment. Many young people having this type of treatment do not have conventional withdrawal of thyroxine replacement but instead are able to have two doses of a drug (called recombinant TSH or rTSH) to activate any possible remaining bits of thyroid tissue before the radioactive iodine treatment is given. This avoids the inconvenience and unpleasant symptoms of thyroid underactivity for several weeks and avoids issues of school absence due to the child feeling unwell.

Although thyroid cancer is a serious problem fortunately it can be treated effectively. There is a 99% chance of survival and subsequent good health after this treatment for children and adolescents.

Disorders of the Thyroid Gland in Children and Adolescents

Questions and Answers

My child went to the doctor because of tiredness. Her TSH level was 5.7 mU/L. Is this significant and does it need treatment?

Although there is no evidence that treating small increases in TSH (up to 10 mU/L) makes any difference to the child, and the TSH often returns to normal without treatment, it is advisable to have follow-up to ensure that the TSH normalises and that there is no other underlying disorder.

My child has been treated for Graves' disease for 6 months. Her test results are better. Can I stop treatment?


No. If treatment is stopped the problem is extremely likely to return within weeks or months. Treatment is needed for at least 18 months to hope for a long time without treatment (remission).

The local doctor found a lump in my child's thyroid gland. Is this serious?

Yes. Single lumps in a child's thyroid gland have a much higher risk of being cancerous than a similar lump in an adult.

My teenager needs a dose of radioactive iodine. She has been told she cannot go to school or see her friends. How dangerous is this treatment?

The reason to separate a person from others after a dose of radioactive iodine is to protect the family and community from unnecessary radiation exposure. It does not harm the patient.



My child developed an underactive thyroid when she was 4 years old. I heard this causes brain damage.

Not true. Babies need thyroid hormone for brain development and brain damage can occur if thyroid levels are not correct up to age 2-3 years. After that the brain is not damaged by lack of thyroid hormone, although a child who has low levels can seem to be slowed down until the level is corrected.

My child's marks at school are terrible since her underactive thyroid was diagnosed and treated. I thought he would get better, but he is worse. Why?

When thyroid hormone levels are returned to normal, every part of the body speeds up to normal. The brain works better, but the child may seem to be overactive for a while with poor concentration. This will recover. You may need to tell the teacher to expect a few months of adjustment.

My child has had cancer in their thyroid gland. It spread to their neck and chest. Will she die?

Although thyroid cancer is serious and needs careful treatment, more than 99% of children with this problem survive, so the outlook is very good indeed.

[illegible]



Glossary

Adenoma

A type of non-cancerous (benign) tumour that arises from glandular tissue or has a gland-like structure.

Agranulocytosis

A condition where the bone marrow does not make enough of a certain type of white blood cells (granulocytes). It can be a result of a reaction to medications or exposure to radiation, chemotherapy drugs or toxic chemicals.

Athyreosis

Absence of the thyroid gland.

Autoimmune

A process in which the body mistakenly sees part of itself as being abnormal and tries to attack it.

Congenital

Present at birth.

Dyshormonogenesis

Abnormal production of a hormone (dys means 'abnormal' and genesis means 'production of').

Endocrine Glands

Endocrine glands secrete substances called hormones into the bloodstream. The endocrine glands include the thyroid, the pituitary, the ovaries and the testicles.

Disorders of the Thyroid Gland in Children and Adolescents

Endocrinologist

A doctor specialising in the treatment of hormone disorders, including thyroid disorders.

Foetal

Relating to the early stages of a developing baby in the womb (foetus).

Genetic

Pertaining to genes, which are the units on the chromosomes that transmit inheritance of one or more characteristics.

Goitre

A visible swelling of the thyroid gland in the front of the neck.

Hormone

A chemical substance that is made by an endocrine gland and then secreted into the bloodstream. There are a large number of hormones that have widespread effects on the body, such as thyroid hormone, growth hormone, insulin and cortisol.

Hyperthyroidism

A condition in which the thyroid gland is overactive and produces too much of the hormone thyroxine.

Hypothyroidism

A condition in which the thyroid gland is underactive or absent. The term congenital hypothyroidism means that the condition is present at birth, while acquired hypothyroidism occurs during later childhood or adolescence.



Lingual thyroid

A lingual thyroid gland results from problems occurring during the early stages of the gland's development. During these early stages, the thyroid gland is at the back of the tongue and migrates, as the foetus develops, to the front of the neck. When it fails to migrate properly, it can remain high in the neck or at the back of the tongue.

Maternal

Relating to the mother.

Metabolism

All of the processes that occur in the body that turn the food you eat into energy your body can use. It is the chemical activity that occurs in cells, releasing energy from nutrients or using energy to create other substances, such as proteins.

Neonatal

Relating to a newborn infant (a neonate).

Nuclear medicine scan

A nuclear medicine scan uses small amounts of radioactive 'tracers' introduced into the body to provide information about how well different organs or organ systems are working. A special camera is used to take images of the 'tracer' within the body. These images are then processed by a computer to provide information about the target organ.

A nuclear medicine thyroid scan shows activity of the thyroid cells, the size and shape of the gland, and any nodules or lumps in the gland.

Disorders of the Thyroid Gland in Children and Adolescents

Paediatric Endocrinologist

A doctor who specialises in the disorders of endocrine glands in children.

Thyroid Gland

An endocrine gland that produces thyroid hormone. It is a butterfly-shaped gland that is located in the front of the lower part of the neck and consists of two connected lobes on each side of the windpipe.

Thyroid Hormone

The hormone produced by the thyroid gland (also called thyroxine). The tablets given to treat hypothyroidism contain this hormone. Thyroid hormone is sometimes called T4 or Free T4, particularly on blood test request forms and results.

Thyroid Scan

This is a test to see the position and shape of the thyroid gland and to determine if the gland is absent, ectopic or present in the normal position.

Thyroid Stimulating Hormone (TSH)

A hormone that is produced by the pituitary gland and which stimulates the thyroid gland to secrete thyroid hormone (TSH is also called thyrotropin).

Thyrotoxicosis

A condition in which there are excessive amounts of thyroid hormone in your body. It may be due to overproduction by the thyroid gland (hyperthyroidism) or some other reason, such as a medication you are taking. The two terms, hyperthyroidism and thyrotoxicosis, tend to be used interchangeably.



Triiodothyronine (T3) and thyroxine (T4)

The thyroid gland takes iodine, a natural element present in many foods, and converts it into the thyroid hormones: triiodothyronine (T3) and thyroxine (T4). T3 and T4 are then released into the bloodstream and are transported around the body. They control your body's metabolism and help regulate growth.

Trisomy 21 (Down syndrome)

Down syndrome (trisomy 21) is a genetic condition that occurs when someone is born with an extra chromosome, so they have 47 chromosomes instead of the usual 46. The extra chromosome is usually an additional copy of chromosome 21. Having this extra chromosome causes problems with the way the body and brain develop.

Urticaria

An allergic rash with swollen, red, itchy patches on the skin (sometimes called hives).

Support Organisations and Further Reading

Australasian Paediatric Endocrine Group (APEG)

www.apeg.org.au

The Endocrine Society

www.endo-society.org

The Australian Thyroid Foundation (ATF)

www.thyroidfoundation.com.au

Thyroid Australia.

www.thyroid.org.au

UK British Thyroid Foundation

www.btf-thyroid.org

UK Society for Endocrinology

www.endocrinology.org

Thyroid Foundation of America (TFA)

www.allthyroid.org



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Disorders of the Thyroid Gland in Children and Adolescents

Merck Australia is proud to bring you this booklet from the *Hormones and Me* educational series. We aim to provide readers with a better understanding of the issues relating to endocrine disorders particularly in children. We hope that you find it a valuable and helpful resource.

Please ask your doctor or nurse for further information on the resources available to you.

The *Hormones and Me* series includes:

1. Growth Problems in Children
2. Turner Syndrome
3. Craniopharyngioma
4. Diabetes Insipidus
5. Puberty and its Problems
6. Delayed Puberty
7. Multiple Pituitary Hormone Deficiency (MPHD)
8. Congenital Adrenal Hyperplasia (CAH)
9. Growth Hormone Deficiency in Adults
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11. Intrauterine Growth Retardation (IUGR)
12. Congenital Hypothyroidism
13. Klinefelter Syndrome
14. Disorders of the Thyroid Gland in Children and Adolescents



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Hormones and Me

Disorders of the Thyroid Gland in Children and Adolescents

This booklet is valuable reading for parents of children and
adolescence with thyroid disorders.

It is also recommended reading for their family and friends.

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